Introduction

Of all the Indiana Air Pollution Rules, 326 IAC 8 is the most complex and most often misunderstood. This guide is to ease the process of preparing the permit forms relevant to this rule.

This guide is only relevant for permit application forms for surface coating operations and printing operations. Other guides will be prepared for degreasing, petroleum operations, pharmaceutical operations, and plastic and rubber molding operations at a later date.

Surface coating, in general, refers to the application of organic substances to metal, plastic, rubber, wood, paper, or other substrates to enhance the performance of a product. This includes, but certainly is not limited to, such things as:

> Paint
> Rustproofing
> Adhesives
> Magnetic Coatings
> Lubricant Coatings
> Powder Coatings
> Stains
> Varnishes and Shellacs

Many types of surface coating require specific limitations on emissions of volatile organic compounds per unit volume of coating applied. For the rule that applies to your coating operation and its associated limit, consult 326 IAC 8 and 40 CFR 60.

Equipment covered by this rule includes application equipment such as spray booths, flow coaters, and dip tanks; and drying equipment such as air dryers, flash off areas, and curing ovens.

Specifically excluded from surface coating is the degreasing and other surface preparation operations that may be required. Other air pollution rules - beyond the scope of this guide - may apply.

General Procedure:

Surface Coating:
1. Unless you are applying a coating to wood furniture or components of non-upholstered furniture, it is necessary to

    complete the "VOC Data Sheets" for each coating applied. These forms determine the amount of volatile organic compounds (VOC) that will be emitted into the atmosphere per gallon of coating applied. There are two parts of these forms. One is the "as supplied" forms. This determines the VOC content of the coating as it is supplied by the coating manufacturer. As many users "thin" or dilute the coatings prior to application, the second part determines the VOC content of the coating as it is delivered to the coating applicator. With the exception of the wood furniture coating operations described above, all coating operations subject to 326 IAC 8-2 have VOC emission limits described in terms of pounds of VOC per gallon of coating less water delivered to the applicator.

2. In any case, a surface coating operation will require filling out Forms W-1 and W-2. These forms use some of the information used in completing the VOC data sheets. These forms allow us to estimate your overall VOC emissions.

3. Send in a copy of Material Safety Data Sheets for each coating, thinner, and cleanup solvent used in the coating operation. You need only send the sections that state the hazardous material contents of these materials.

4. Indicate clearly what you are surface coating and the material utilized to produce the product.

As Supplied

Step I. "As Supplied" VOC Data Sheets

1.   Your coating supplier should be able to supply a properly filled out VOC Data Sheet, as the U.S. EPA requires
     coating manufacturers to provide this data. If your supplier has provided you properly filled out VOC Data
     Sheets, skip ahead to Step II. If you have obtained your coating material from an intermediary that cannot supply
     a filled out VOC Data Sheet, you can fill out these sheets yourself.

2. From your Material Safety Data Sheet (MSDS), retrieve the following information:

   a.) Coating Density in pounds per gallon   This will be called $(D_c)_s$
   b.) Weight Percentage of Volatiles - both organic and water   This will be called $(W_v)_s$
   c.) Weight Percentage of Water   This will be called $(W_w)_s$

3.   Calculate Weight Percentage of Organic Volatiles - $(W_o)_s$ - using data obtained in step number 2. with the
     following equation:

   $$(W_o)_s = (W_v)_s - (W_w)_s$$

4.   Calculate Volume Percentage of Water - $(V_w)_s$ - Using the following equation and data obtained in above steps:

   $$(V_w)_s = \frac{(W_w)_s (D_c)_s}{D_w}$$ where D_w is density of water = 8.33 lb/gal

5.   Calculate VOC Content "As Supplied" - $(VOC)_s$ - using data obtained above and the following equation:

   $$(VOC)_s = \frac{(W_o)_s (D_c)_s}{100\% - (V_w)_s}$$

6.   If the coating "As Supplied" does not contain any water, then $(V_w)_s = 0$, therefore: $(VOC)_s = (W_o)_s (D_c)_s$

Example for equations mentioned in numbers 3, 4, 5:

   Coating density = $(D_c)_s$ 11.66 lb/gal
   Weight percent of volaitles = $(W_v)_s$ 41.97 %
   Weight percent of water = $(W_w)_s$ 40 %

3.   5.
$(W_o)_s = (W_v)_s - (W_w)_s$ $(VOC)_s = \frac{(W_o)_s (D_c)_s}{100\% - (V_w)_s}$

$(W_o)_s = 41.97\%$ - 40.0% $(VOC)_s = \frac{(.0197 \text{ lb VOC / lb coat}) (11.66 \text{ lb coat/gal coat})}{(1.00 \text{ gal coat / gal coat}) - (.56 \text{ gal H2O / gal coat})}$

$(W_o)_s = 1.97\%$ $(VOC)_s = .52$ lb VOC /gal coat - gal water
                                                    $(VOC)_s = .52$ lb VOC / gal coat less water
4.
$(V_w)_s = \frac{(W_w)_s (D_c)_s}{D_w}$

$(V_w)_s = \frac{(0.40 \text{ lb H2O / lb coat}) (11.66 \text{ lb coat / gal coat})}{8.33 \text{ lb H2O / gal H2O}}$

$(V_w)_s = .56$ gal H2O / gal coat
$(V_w)_s = 56 \%$

As Applied

Step II. "As Applied" VOC Data Sheet

1. If you do not "thin" or dilute the coating prior to application, then the VOC content "As Applied" is the same as the VOC content "As Supplied". Simply fill out "as applied" VOC Data Sheet as:

$(VOC)_a = (VOC)_s$

2. If you do "thin" or dilute your coating, the amount of VOC that is emitted may change, so the VOC content must go adjusted accordingly. The following additional data is needed:

Weighted Average Density of Dilution Solvent in lb/gal - (D_d)

$(D_d) = 3 \, f(D_i) \, (\%_i/100)_n$

If a coating is diluted with a multiple component "thinner", the density of the dilution solvent is the weighted average density of the component solvents. For example, if a coating were to be diluted with a mixture with three components - 10% solvent A with a density of 6.5 lb/gal, 40% solvent B with a density of 8.33 lb/gal, and solvent C with a density of 7.0 lb/gal; the weighted average density - (D_d) - would be calculated as follows:

Solvent	Weight Percentage		Density lb/gal		Product lb/gal
A	10%	X	6.50	=	0.650
B	40%	X	8.33	=	3.332
C	50%	X	7.00	=	+3.500
	100%				
Mixture Weighted Average - (D_d)					7.482 lb/gal

Include water and non-photochemically reactive solvents in this calculation.

3. Calculate dilution ratio - R_d. This is simply the volume ratio of photochemically reactive organic dilution solvent to the "as supplied" coating.

$R_d = \dfrac{\text{Volume of Photochemically Reactive Dilution Solvent}}{\text{Volume of "as supplied coating"}}$

Where:
Volume of Photochemically Reactive Dilution Solvent =
(volume of dilution solvent) ·1-(volume % water) - (volume % of non-photochemically reactive organics)

For example, assume that a gallon of "as supplied" coating is thinned with 3 gallons of a mixture that consists of 7 quarts xylene, 2 quarts of 1,1,1 trichloroethane, and 3 quarts water. Therefore:

Volume of Photochemically Reactive Dilution Solvent =

(3 gal) ·1-(2 qt/12 qt)-(3 qt/12 qt) = 1.75 gallons therefore:

R_d = 1.75 gallons Photochemically Reactive Dilution Solvent = R_d = 1.75 for this example
       1.00 gallon "as supplied" coating

Note: 1,1,1 trichloroethane is not photochemically reactive refer to 326 IAC 1-2-48 of non-photochemically reactive organics or the definition provided in the instructions.

4.   Determine Density of coating "as applied" - $(D_c)_a$ - using method described in ASTM[1] D1475-85 in pounds per gallon.

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5.   Calculate volatile organic content of coating "as applied" - $(W_o)_a$ - using data obtained in previous steps and the following equation:

$$(W_o)_a = \frac{(D_c)_s \, (W_o)_s/100 + (R_d)\,(D_d)}{(D_c)_s + (R_d)(D_d)} \times 100$$

6.   Determine Weight Percent Water of "as applied" coating - $(W_w)_a$ - using method ASTM D3792-86 or ASTM D4017-88. These tests should be performed by a suitably equipped laboratory. If no water is present in the dilution solvent, obviously $(W_w)_a = (W_w)_s$, and these tests need not be performed.

7.   Calculate Volume Percent Water in coating "as applied" - $(V_w)_a$ - using data obtained in the above steps and the following equation:

$$(V_w)_a = \frac{(W_w)_a (D_c)_a}{D_w}$$ where D_w is density of water, D_w = 8.33 lb/gal

8.   Calculate VOC content of "as applied" coating - $(VOC)_a$ - using data obtained in the above steps and the following equation:

$$(VOC)_a = \frac{(W_o)_a \, (D_c)_a}{100\% - (V_w)_a}$$

Alternately, the following equation may be used:

$$(VOC)_a = \frac{[(VOC)_s \, (100\% - (V_w)_s)/100] + [(R_d)(D_d)]}{1 + R_d - [(V_w)_s/100]}$$

Step III. Solids Content of Coating by Volume

1.   From the Material Safety Data Sheet (MSDS) or other information from the coating supplier, ascertain the solids content by volume of the coating "as supplied". This figure is referred to as $(V_n)_s$. Enter this figure onto the "as supplied VOC Data Sheet. If the coating is not "thinned" or diluted prior to application , then $(V_n)_s = (V_n)_a$. If such is the case, enter onto the "as applied" VOC Data Sheet, and go on to Step IV.

2.   If the coating is "thinned" or diluted prior to application, calculate the Volume Percentage of Solids "as applied" using data obtained in the above steps and the following equation:

$$(V_n)_a = \frac{(V_n)_s}{1 + R_d}$$

Step IV. VOC Content per Unit Volume Solids

1.   Calculate VOC Content per Unit Volume of Solids - $(VOC)_{as}$ - using data developed using steps described above and the following equation:

$$(VOC)_{as} = [(VOC)_s \, (100\% - (V_w)_s)/100 + (R_d)(D_d)]$$

$$(V_n)_s/100\%$$

or alternately:

$$(VOC)_{as} = \frac{(W_o)_a(D_c)_a}{(V_n)_a}$$

Enter this figure on the "as applied" VOC Data Sheet.

_____[1]EPA's Reference Method 24 (40 C.F.R. Part 60, App. A), contains the ASTM methods referenced in these instructions.